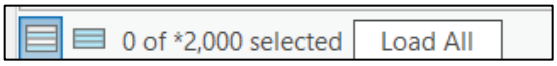
Mapping Tabular Data – Display XY points from csv

Materials needed: *AussiePublicToilets.csv*.

[1] Open and examine the data:

Open a new Project in ArcGIS Pro and use the **Add Data** button to add the table *AussiePublicToilets.csv* to the map. **Right-click** on the csv and choose **Open** to open the table. Take a moment to inspect the field (column) names and the values beneath them. If you click **Load All** at the bottom of the table, you will see that there are 18,865 records, each representing one public restroom, though none show up on the map yet.



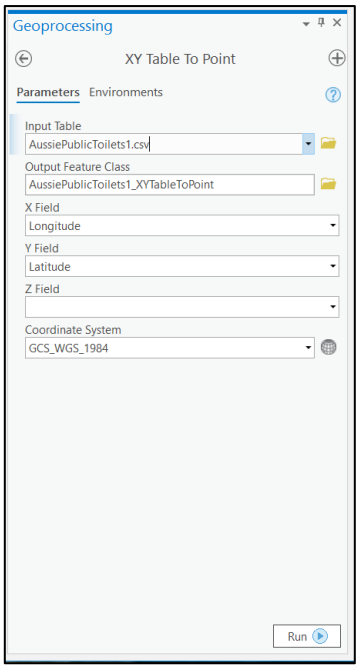
Notice that there are columns for Latitude and Longitude, and that the values in these columns look a lot like decimal degrees. (Metadata confirms that the data were recorded using the GCS_WGS84 coordinate reference system.)

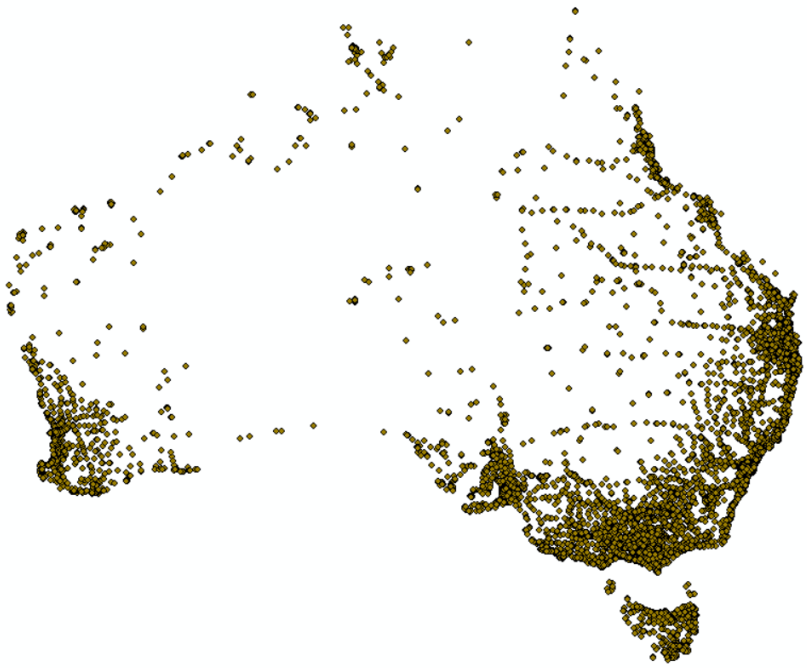
[2] Set the Map coordinate system to WGS84:

Right-click on the word Map in the Table of Contents, then **Properties**, then choose the tab for **Coordinate System**. If the Map is not already in some version of **WGS 1984**, search for that and choose the plain version that lives under **Geographic Coordinate Systems > World**. Notice that the units shown on the coordinates in the bottom edge of the map are decimal degrees.

[3] Plot the coordinates as points:

Right-click on table in the Table of Contents. Choose **Display XY Data.** A dialog box opens, asking which fields to use as X and Y coordinates. Choose Longitude for X, Latitude for Y. You will also need to choose the name and location to save your output to (Output Feature Class). For now, let everything save to the Project geodatabase.

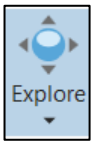


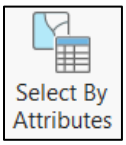


Mapping Tabular Data – Select a Subset by Attributes

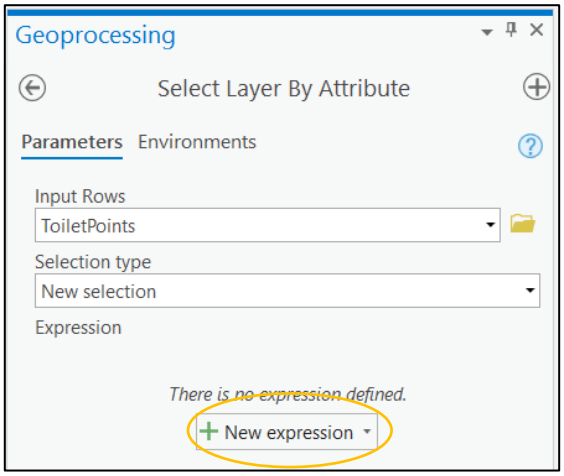
[1] Click the **Select** icon in the Map Ribbon. Practice click-selecting on the Australian points. **Shift-click** will allow you to select several points. You can also hold down the left mouse button and drag a box to select a large area. When you are done, **Clear Selected Features**.

At any time, you can return to a regular cursor by clicking on the **Explore** button.

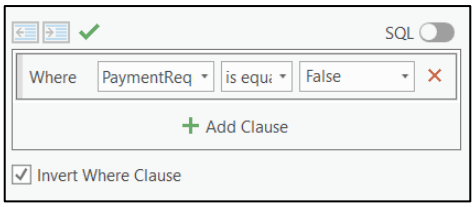




[2] In the Map Ribbon, choose **Select by Attribute**. A calculator opens, where you will concoct a logical expression. First, click **+ New Expression**.



A new set of options appears:



Use the pull-down menus to build the expression:

[PaymentReq] [is equal] [False]

Then click **Run.**

[3] Inspect the map and the Attribute Table. 162 public toilets were excluded from the selection. Experiment with the **Switch Selection** button at the top of the table, and **Show Selected Records** at the bottom.

[4] Narrow the selection by launching **Select By Attributes** again. This time, change **Selection Type** to "Select Subset from Current Selection" and build the expression "KeyRequire" = 'False' and inspect the updated selection. These are all of the public bathrooms on the entire continent that are open access, no key or payment required.

[5] Data selections are temporary. To make a new layer containing only the selected portion of the old, **right-click** on the name of the points layer in the Table of Contents (while the features are selected) and choose **Data > Export**. Give the output a name and click **Run**.

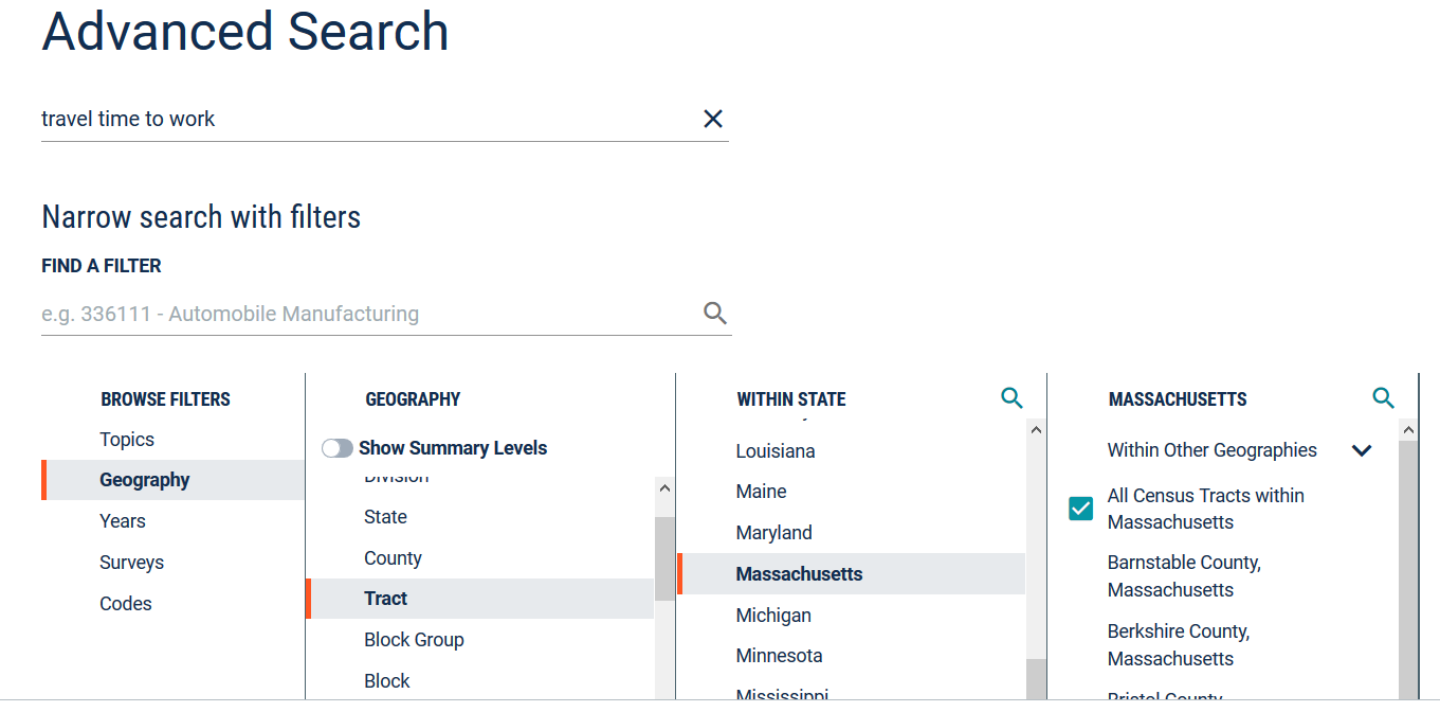
Close Pro for now.

Mapping Tabular Data – Joining Census Tables

Materials needed: the census.data.gov website, *Middlesex_Tracts.shp*, and *Travel_90min.csv*

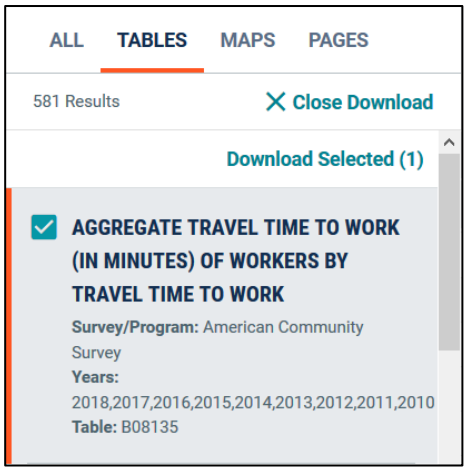
[1] Open a browser and navigate to https://data.census.gov/cedsci/advanced.

[2] At the top, type **travel time to work**. For Geography, choose **Census Tracts**. Choose **Massachusetts** and **Middlesex County**. Then choose **All Census Tracts within Massachusetts.** Finish this step by clicking **[SEARCH]** and selecting the first table in the results, table B08135.



[3] In the left-hand pane, choose **Download**, click the box next to table B08135, and choose **Download Selected**. If prompted, choose file format **CSV**.

Unzip your downloaded folder, navigate to it, and open the file *2018.B08135_data_with_overlay* with Excel or Notepad to inspect it.



[4] Notice a few things about this spreadsheet. The first row contains indecipherable census codes for each variable. The second row contains more readable descriptions, but those descriptions have punctuation that may confuse ArcGIS Pro. Pro is not prepared to handle data with two header rows. Furthermore, there are many more columns than we may want to use.

GEO_ID	NAME	B08135_001E	B08135_001M
id	Geographic Area Name	Estimate!!Aggregate travel time to work (in minutes)	Margin of Error!!Aggregate travel time to work (in
1400000US25001011300	Census Tract 113, Barnstable County, Massachusetts	31340	8121
1400000US25001012002	Census Tract 120.02, Barnstable County, Massachusetts	22155	5601
1400000US25001014300	Census Tract 143, Barnstable County, Massachusetts	39485	9463
1400000US25001014800	Census Tract 148, Barnstable County, Massachusetts	35020	8816
1400000US25001990000	Census Tract 9900, Barnstable County, Massachusetts	-	**
1400000US25005640901	Census Tract 6409.01, Bristol County, Massachusetts	48645	12194
1400000US25005650800	Census Tract 6508, Bristol County, Massachusetts	35835	7571
1400000US25005650900	Census Tract 6509, Bristol County, Massachusetts	22670	5484
1400000US25005990000	Census Tract 9900, Bristol County, Massachusetts	-	**
1400000US25007200200	Census Tract 2002, Dukes County, Massachusetts	21595	4163
1400000US25007990000	Census Tract 9900, Dukes County, Massachusetts	-	**
1400000US25009218100	Census Tract 2181, Essex County, Massachusetts	84075	12108
1400000US25009250100	Census Tract 2501, Essex County, Massachusetts	26625	8850
1400000US25009990100	Census Tract 9901, Essex County, Massachusetts	-	**
1400000US25011041300	Census Tract 413, Franklin County, Massachusetts	36915	7020
1400000US25013801502	Census Tract 8015.02, Hampden County, Massachusetts	20250	4247

Suppose we are only interested in super-commuters, people who commute more than 90 minutes to work, the second-to-last column. We could remove unwanted columns and rename the headers like this:

	A	B	C	D	E
1	GEO.id	GEO.id2	CensusTract	TotalPop	90min
2	1400000US25017300100	25017300100	Census Tract 3001, Mid	1585	116
3	1400000US25017301101	25017301101	Census Tract 3011.01, I	1894	33
4	1400000US25017301102	25017301102	Census Tract 3011.02, I	2774	111
5	1400000US25017310100	25017310100	Census Tract 3101, Mid	2594	128
6	1400000US25017310200	25017310200	Census Tract 3102, Mid	3332	10
7	1400000US25017310300	25017310300	Census Tract 3103, Mid	2461	22

★ **This has already been done for you and is saved in your lab materials as *Travel_90min.csv*.**

Map | Travel_90min.csv

Field: Add Delete Calculate Selection: Zoom To Switch Clear Delete Copy

GEO.id	GEO.id2	CensusTract	TotalPop	90min
1400000US25017300100	25017300100	Census Tract 3001, Mi...	1585	116
1400000US25017301101	25017301101	Census Tract 3011.01,...	1894	33
1400000US25017301102	25017301102	Census Tract 3011.02,...	2774	111
1400000US25017310100	25017310100	Census Tract 3101, Mi...	2594	128
1400000US25017310200	25017310200	Census Tract 3102, Mi...	3332	10
1400000US25017310300	25017310300	Census Tract 3103, Mi...	2461	22
1400000US25017310400	25017310400	Census Tract 3104, Mi...	1467	8
1400000US25017310500	25017310500	Census Tract 3105, Mi...	1731	62
1400000US25017310601	25017310601	Census Tract 3106.01,...	3048	195
1400000US25017310602	25017310602	Census Tract 3106.02,...	2838	33

0 of 318 selected Filters:

Middlesex_Tracts

Field: Add Delete Calculate Selection: Zoom To Switch Clear Delete Copy

FID	Shape	STATEFP	COUNTYFP	NAMELSAD	ALAND	AWATER	GEOID2	text_geoid
0	Polygon	25	017	Census Tract 3212	4596280	962007	25017321200	025017321200
1	Polygon	25	017	Census Tract 3837	4293522	369224	25017383700	025017383700
2	Polygon	25	017	Census Tract 3838	5269623	304363	25017383800	025017383800
3	Polygon	25	017	Census Tract 3851	17363842	579477	25017385100	025017385100
4	Polygon	25	017	Census Tract 3221	14081676	557716	25017322100	025017322100
5	Polygon	25	017	Census Tract 3394	629016	25734	25017339400	025017339400
6	Polygon	25	017	Census Tract 3531.02	901795	698900	25017353102	025017353102
7	Polygon	25	017	Census Tract 3689.01	4020837	25552	25017368901	025017368901
8	Polygon	25	017	Census Tract 3531.01	411670	0	25017353101	025017353101
9	Polygon	25	017	Census Tract 3173.01	4023677	125860	25017317301	025017317301

0 of 318 selected Filters:

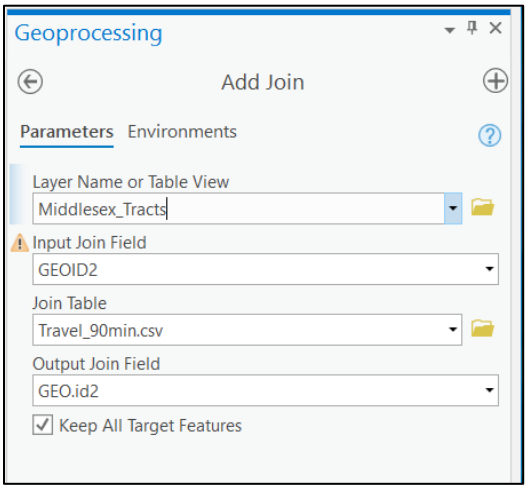
Likewise, the census tracts of Massachusetts have already been selected to the subset for Middlesex county and saved as *Middlesex_Tracts.shp*.

In Pro, open a new map and add both *Middlesex_Tracts.shp* and *Travel_90min.csv*.

We are hoping to find a join key field that matches exactly some field in the tracts shapefile.

Inspecting both tables reveals that GEO.id2 should be a good match for GEOID2. Hover your mouse over the field names and note that the two fields have the same data type.

[5] To begin the join, start with the *Middlesex_Tracts* layer in the Table of Contents. **Right-click** and choose **Joins and Relates > Add Join.** The following dialog box appears:

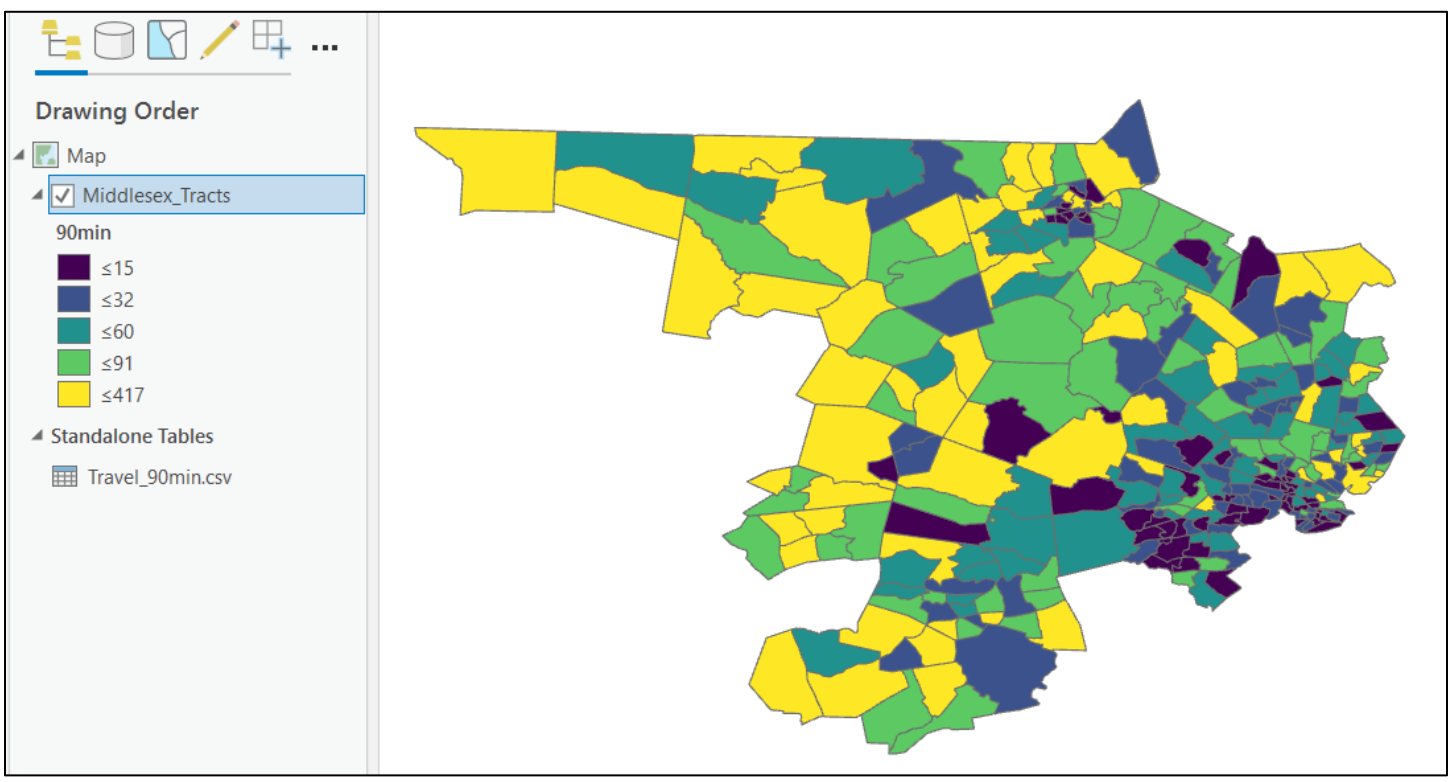


This is where you tell Pro what the right-hand table will be (*Travel_90min*) and what the matching fields will be – GEOID2 and GEO.id2.

Click [**Run]** and then inspect the Attribute Table for *Middlesex_Tracts*. Five newly added columns represent the information from the census table.

FID	Shape	STATEFP	COUNTYFP	NAMELSAD	ALAND	AWATER	GEOID2	text_geoid	Field	CensusTract	TotalPop	90min	GEO.id	GEO.id2
0	Polygon	25	017	Census Tract 3212	4596280	962007	25017321200	025017321200	0	Census Tract 3212, Mi...	3526	82	1400000US25017321...	25017321200
1	Polygon	25	017	Census Tract 3837	4293522	369224	25017383700	025017383700	0	Census Tract 3837, Mi...	3190	44	1400000US25017383...	25017383700
2	Polygon	25	017	Census Tract 3838	5269623	304363	25017383800	025017383800	0	Census Tract 3838, Mi...	2924	51	1400000US25017383...	25017383800
3	Polygon	25	017	Census Tract 3851	17363842	579477	25017385100	025017385100	0	Census Tract 3851, Mi...	3449	150	1400000US25017385...	25017385100

To keep those columns permanently, you must export a new copy of *Middlesex_Tracts* using **Right-click > Data > Export.** For use in the following exercises, please name your export *Middlesex_Joined*. We can now display the census tracts symbolized according to number of residents traveling more than 90 minutes to work:



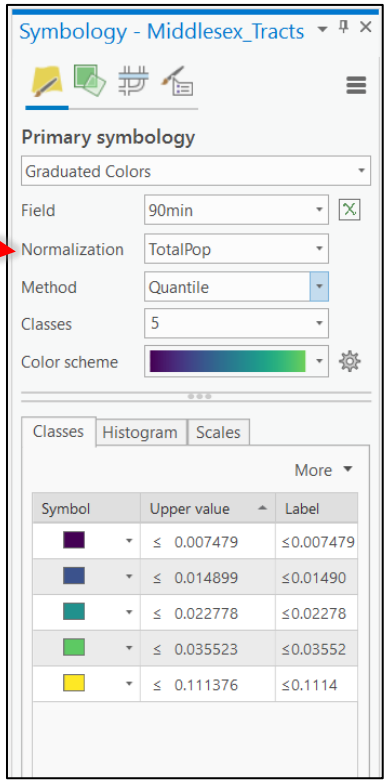
Extra: Field Calculation

Materials needed: *Middlesex_joined*, your exported shapefile from the previous section

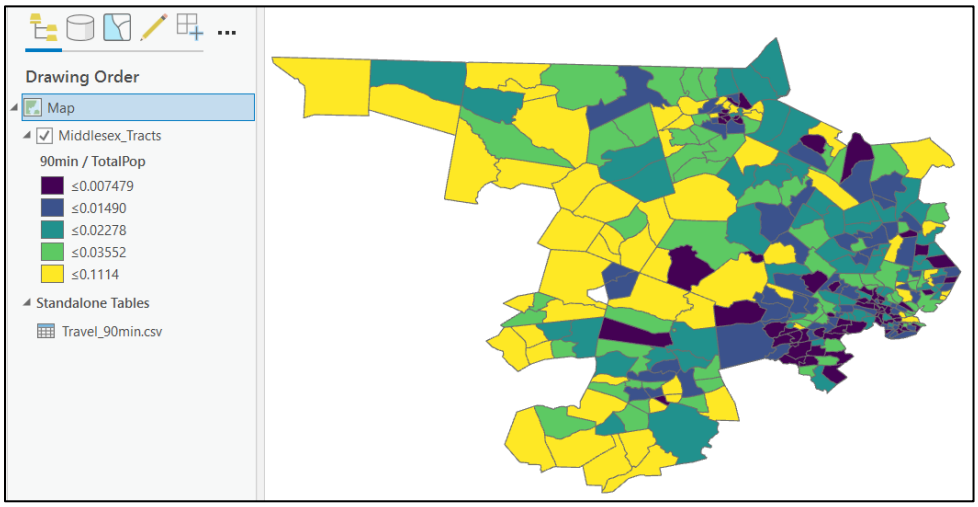
How could we change this map to display the fraction of commuters making this long journey?

Two ways: visually only, using symbology, or with an actual calculation in the Attribute Table.

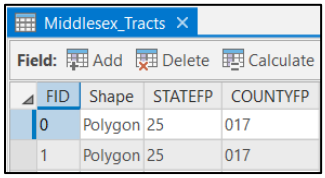
[1] In **Symbology** with a **graduated colors** scheme, we can Normalize the values shown by the field TotalPop.

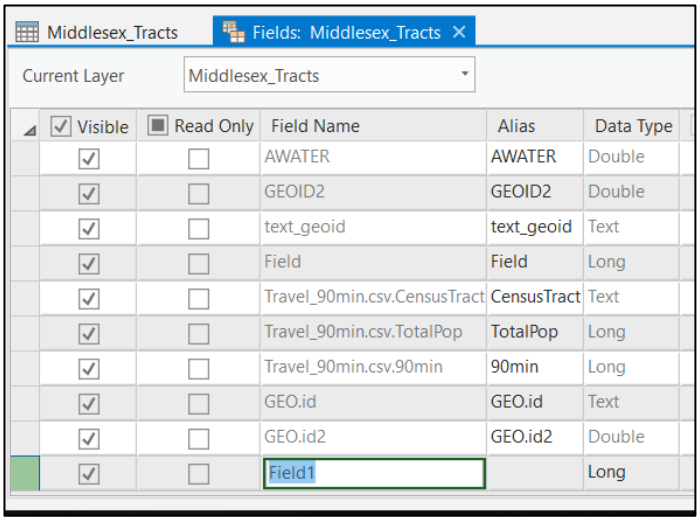


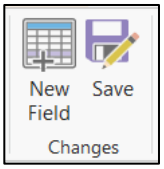
Notice the menu choice <percent of total> in the Normalization drop-down. How is it different from fraction of total population? Which total is meant?



[2] To make a real, permanent calculation of the fraction of super-commuters, open the Attribute Table. Click the **Add** button at the top of the table. That launches the Field View, ready for the name of a new field. Name your new field "Fraction_90" and change the Data Type to Double. Save your new field using the **Save** button in the top ribbon.

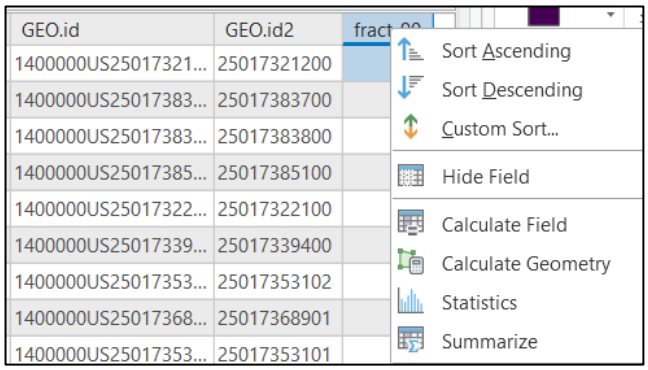


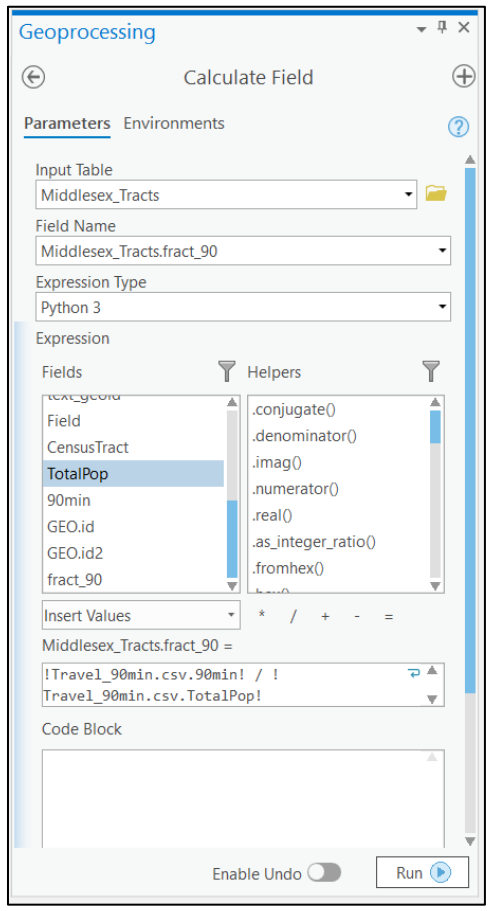




Field names can have no spaces. They must be fairly short and they cannot be re-used. Longer, more descriptive, names can be stored as Field Aliases.

Close the Field View. There is now a new empty field in the Attribute Table. **Right click** at the top of it and choose **Field Calculator**.





Create a formula to calculate values for the new field by choosing *TotalPop*, the division symbol (/) and *90min* from the menus.

(The resulting formula looks somewhat alarming because I forgot to export my join!)

If we were concerned about a denominator being zero, we could add a small number to the denominator: *90min* / (*TotalPop* + 0.01).

Alternatively, we could **Select** those tracts with non-zero populations. If we preferred percentage to proportion, we could use *90min* * 100 / *TotalPop*.

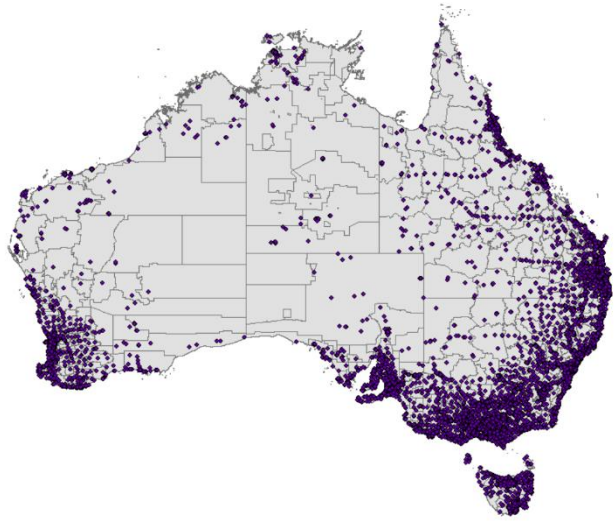
Press **[Run]** to execute the calculation. The field is filled with new values, and Symbology can now make use of them.

Extra: Spatial Join

Materials needed: *AussiePublicToilets.shp, Municipalities.shp*

[1] Open and examine the data:

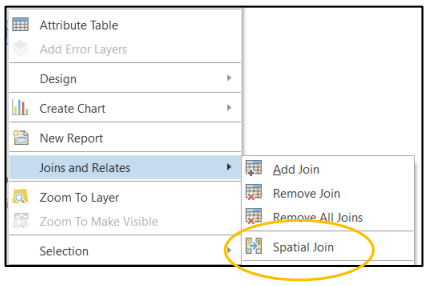
Open Pro and use the **Add Data** button to add both shapefiles to the map.

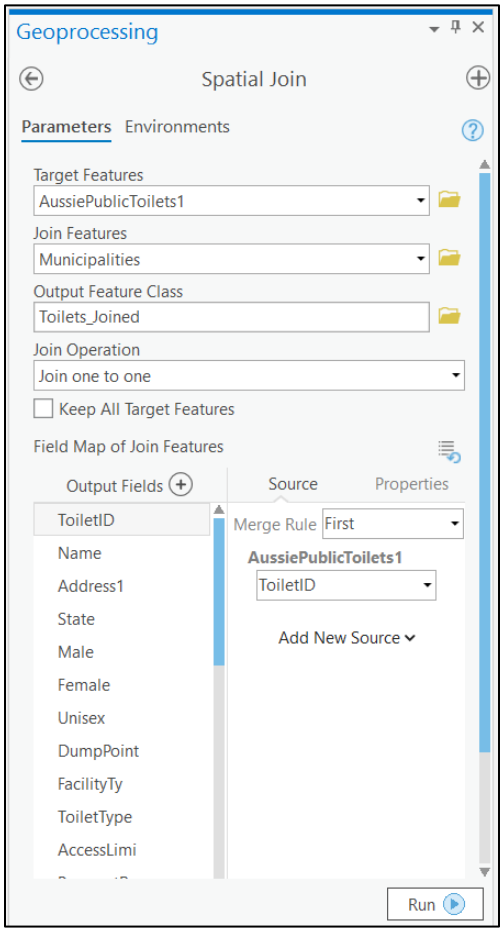


Spatial Join is a technique that associates one layer with the features of another based on their location in space.

[2] First, let's join the *Municipalities* to the *Toilets* layer, so that each point will have information about which municipality it's in. Start by right-clicking on the *Toilets* layer.

Choose **Joins and Relates** and then **Spatial Join.**



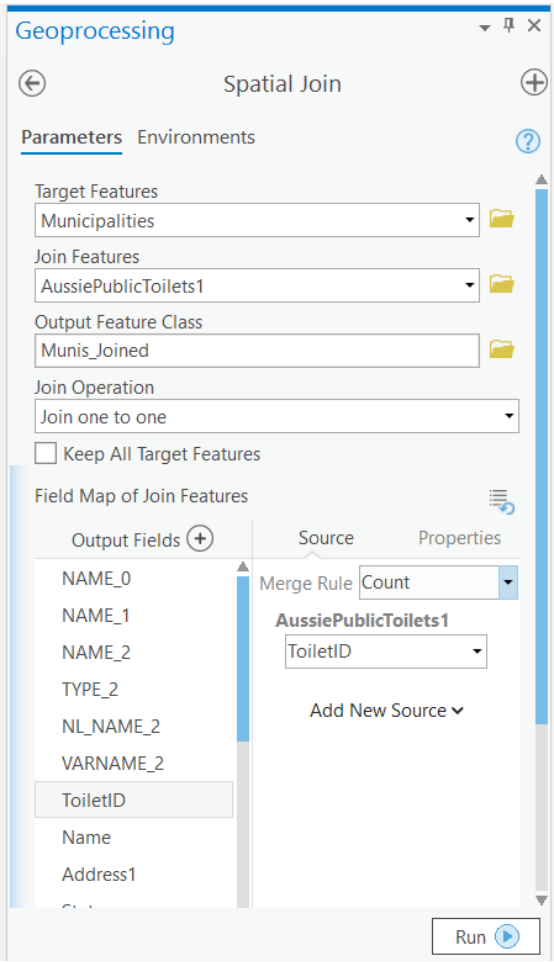


The first time we join, the Target Layer will be the *Toilets* and the Join Layer will be the *Municipalities*. Join one-to-one. Ignore the Field Map options for now.

[Run] the tool and inspect the output. The output is a new set of points, almost identical to the toilets layer, but new columns have been added to the right of the attribute table containing all of the information from the Municipalities shapefile.

[2] Now let's do the opposite: tell each municipality about the toilets it contains. We could spatially join one-to-many, but that would make many copies of each municipality, one for each toilet it contains.

Instead, let's get a summary for each municipality, using one-to-one. Open the Spatial Join tool, and set the *Municipalities* as the Target Layer and the *Toilets* as the Join Layer.



For that, we will need to set a Merge Rule.

Decide which field you would like summary information about, and click it in the list.

Let's get the count of unique toilet ID numbers per municipality – in other words the count of toilets in each.

Click on ToiletID and then change the Merge Rule from First to Count.

Inspect the output. This time, the output is a set of polygons – municipalities -- and a new field has been added to the table: **Join Count**, which gives the count of toilets per municipality.

We can change the symbology to display that quantity.